ruvian mummy was placed at the disposal of Professor Morse by Dr. Wilhelm Reiss, the learned president of the congress, and the discoverer, in association with Dr. Stübel, of the famous Ancon antiquities. An examination of this mummy, which was that of an elderly person, showed that the elements of the hyoid arch were free.

When the attention of Professor Virchow was called to the subject by Professor Morse, that eminent anatomist said that the question had apparently been entirely neglected. He was inclined, however, to support the correctness of the view advanced by the German authorities, and regard the co-ossification of the hyoid arch as occurring only under abnormal or pathological conditions.

Returning home by way of London, while visiting the British Museum of Natural History, we had the good fortune to meet the eminent mammalogist, Professor Flower. When we called his attention to the subject, he expressed the liveliest interest, saying that the observation was entirely new, the separation of the bones of the basi-hyoid being wholly contrary to any thing observed in his own large experience. He had taken the pains of making careful observations of this feature, and had made preparations of full sets of the *os hyoides* both in man and the lower mammalia. In man he had found that co-ossification took place at maturity, and in proof he called attention to a complete series of British hyoids which he had prepared for the College of Physicians and Surgeons. Therefore he would regard this observation of Drs. Wortman and ten Kate as indicating a very important discovery. The collection of human hyoids at the College of Physicians and Surgeons was inspected by Professor Morse, who found it prepared with the skill and knowledge for which Professor Flower is famous. Every specimen, when after maturity, was co-ossified.

Under a co-operative agreement made at the time between the Army Medical Museum and the Hemenway Expedition, the skeletons exhumed from the ancient cities in southern Arizona have been deposited with the former institution; and Dr. Billings is so impressed with the importance of the question, that Drs. Matthews and Wortman have been requested to make it the subject of an exhaustive research. In this work they, with their assistants, are now engaged, and have been supplied with an abundance of material from various races, in order to make the needed comparative observations. A full report thereon will be forthcoming in due time, but it may already be stated that the investigations have been advanced to a stage that fully confirms the opinion originally formed by the observers, — that in the peculiarities of the *os hyoides* is to be found the most distinctive racial character yet observed in human osseous anatomy. Its value in the determination of vexed questions can hardly yet be estimated, but it will undoubtedly prove of great anthropological service.

Dr. Wortman inclines to the view that it will be found that language plays a leading part in determining the form of this feature. The language of the American Indians is such that it requires but slight effort in utterance. An Indian can talk for hours at a stretch with little fatigue, and even a superficial observer will notice the restrained quality of the voice, the tones not being projected as with us. Now, the development of ankylosis being held to proceed from exercise, or irritation of the bone, from muscular action or otherwise, it is evident that in a language like that of the Indians there would be less muscular action exerted upon the hyoid arch than in one like ours, where more force is used, and therefore the co-ossification of the parts would be less encouraged. This view of Dr. Wortman's obtains support in observations made by Mr. Cushing at Zuñi, where he finds that the voices of those who are afflicted with bone-disease differ in quality from those of the tribe at large, and infers that their difference may be due to co-ossification of the hyoid brought about by the disease.

With the foregoing remarks, I hereby submit Mr. Cushing's letter concerning the other important osteological observation mentioned in the beginning.

SYLVESTER BAXTER,
Sec'y Hemenway Expedition.

OLD FARM, MILTON, MASS.,
Nov. 9, 1888.

My dear Morse, — Last evening I chanced to tell Mrs. Hemenway something about the observations we made on the distorted skulls of Los Muertos and Halonawan. She was greatly interested, especially in what Baxter had to say relative to Dr. Virchow's paper before the recent congress, on, I think, deformed American crania. She wished me to write a brief statement of the case and send it to you, as of possible use to Drs. Virchow and Bastian.

While our excavations were in progress, I observed, by keeping close watch over the disinterments, that all, or nearly all, skulls occurring in earth sepulchres, were apparently deformed by artificial means. From the fact, however, that skulls taken from stone graves or cists, or from other sorts of tombs wherein they had been fairly protected, were uniformly and regularly brachycephalic, and showed no other sign of distortion than the occipital flattening from the cradle-board, I was led to infer that those from the earth sepulchres had been deformed by accident; that is, by post-mortem influences.

Subsequent observations, in all of which I was confirmed by Dr. ten Kate, indicated the entire correctness of this inference. For example: no general rule of cranial disfiguration (always with the above instanced exception) was found to prevail. On the contrary, the disfigurations seemed to depend largely, if not wholly, on the positions of the skulls. When the latter were lying on their sides in the graves, at an angle of, say, forty-five degrees, one side of the coronal region would be depressed, and sometimes the face, even, would be obliquely distorted, as in Fig. 1 of the accompanying slips. Again, when the skeleton was lying on its back, with head elevated, the crown would be greatly depressed, as in Fig. 2; or, if the head happened to be less elevated, face partially upturned, the frontal region was invariably more or less flattened and broadened, as in Fig. 3; or if, finally, the head chanced (face still upward) to be greatly depressed, the parietal region was flattened, throwing the frontal forward sometimes to an extraordinary degree, as in Fig. 4.

Perhaps the most extreme of these cases of post-mortem distortions of skulls were those which, belonging to skeletons of persons who had been buried on their sides, were so regularly flattened laterally that they seemed unmistakably to belong to the dolichocephalic class, as in Fig. 5. In fact, the only examples of "long-headed" skulls found during our researches, in either the north or the south (among the ancient ruins, that is), were so plainly distorted by this post-mortem pressure, that they made no exception to the rule established by Dr. ten Kate, that the Pueblo or Aridian was a short-headed race.

All this is simply due to the practice of blanket-burial. The skulls, being unprotected during the earlier years of burial, are, by the pressure of the earth, gradually deformed, — so gradually, indeed, that they neither crack, nor do the sutures part. The deformities are therefore in no wise distinguishable, after the specimen is removed from its original resting-place, from those produced by art. We are now, therefore, forced to note, in collecting our crania, their relative positions in the earth sepulchres very carefully.

I sincerely hope this may prove useful to Drs. Bastian and Virchow, or at least of some interest to them and the many other gentlemen who were so courteous to you and Mr. Baxter.

Faithfully yours,
FRANK HAMILTON CUSHING.

The Julien Electric Traction System.

IN the opening pages of your journal of Dec. 21, 1888, a description is given of the Hauss Electric Railway, and comparisons are made between that system and other systems of electric traction. A paragraph is devoted to pointing out what the writer claims to be the defects of the storage-battery system.

It is very much to be deplored that some electrical railway companies attempt to raise their own systems in the public estimation by crying down other systems. What is still more deplorable is, that, in attempting to do this, they are not always friends to truth. There could be no better proof of this than the paragraph I have above referred to on the storage-battery system.

The writer admits that the storage-battery plan "would seem to be the ideal system," for the reason, among others, that "it dispenses with the necessity of a continuous conductor, the electrical generator and motive power are all contained within the car, and there is apparently an entire absence of any possibility of danger to the passengers." The writer goes on to say that "these favorable anticipations would be justified were it once demonstrated that a storage-battery had been devised that was economical of power, of reasonable weight, and durable in service." The writer

then goes on to say that "the best storage-battery that has been devised is very wasteful as a source of motive power, yielding at most but forty per cent of the power applied." Now, nothing could be further from the truth than this statement. There is probably not a storage-battery at present on the market that will not yield eighty per cent of the power applied. Almost any person of electrical knowledge and experience knows this to be a fact; and, if further proof be necessary, it will afford me much pleasure to have you send an expert, at my expense, to the electric station of the Julien Electric Traction Company, 85th Street and Madison Avenue, this city, to verify for himself the truth of this statement. He can there see for himself the number of watts the battery receives from the dynamo; and, if the battery does not discharge over eighty per cent of the watts so received, you are welcome to publish the fact to the world.

The next objection the writer raises to the storage-battery system is, that it is "excessively heavy and bulky, making it necessary to carry about three times the load of an ordinary car." Now, "the load of an ordinary car" (16-foot car) is 3 tons: consequently a storage-battery car would have to carry 9 tons of battery, if we are to believe the writer. Now, Car No. 3 of the Julien Electric Traction Company, at present running on Fourth and Madison Avenues in this city, carries just 120 elements, or cells, of battery, each element weighing exactly 27 pounds, or 3,240 pounds; or, with the trays and containing-boxes, 3,600 pounds, — a little over 1¾ tons, instead of 9 tons, as the writer would have us believe. Let me add, in connection with the weight of a storage-battery car, what every engineer knows, that in a locomotive (which the storage-battery car is), to have adhesion, you must have weight.

The 120 cells above referred to contain 52 horse-power hours, and will carry that car over the streets of New York, without being recharged, for a distance of at least thirty-six miles, and carrying over four hundred passengers in all. If the Hauss Electric Railway is now doing equally acceptable and economical work, it would be very interesting for the public to know it. The writer omitted, by the way, to state where the Hauss electric system may be seen, and what practical experience, if any, it has had.

The writer goes on to say that the storage-battery system requires a special car to be built, to provide the necessary space beneath the seats to receive the battery. This is equally untrue. Car No. 3, above referred to, is an old horse-car, and was altered at an expense of about two hundred and fifty dollars for its present purpose. The alteration required is the lifting of the car-body some five inches above its present position.

The next objection the writer has to the storage-battery is, that it "has a life of only two years of constant service, and it is subject to the danger of short-circuiting, which at once destroys its usefulness." The remark as to short-circuiting is very amusing. Am I to understand that the motors constructed by the Hauss Electric Railway (if they do actually construct any) are not subject to the danger of short-circuiting? If so, we must assume that their usefulness is destroyed. Now, we all know that the experience of every electric railway in the country is that the electric-railway motor has the same tendency to short-circuit that the most peevish mule has to kick. If the short-circuited motors of 1888 were made a pile of, we should not need to go to Egypt to see a pyramid. The fact is, that, since the fifteenth day of September last, up to the present moment, we have not short-circuited a battery in our street-car service, although our cars have run in that time in passenger-service some seven thousand miles. This storage-battery short-circuiting is a thing of the past. The cells are at present so connected that short-circuiting is impossible; for the connector would be blown out of position by an excessive current, and thus save the battery. We should be pleased to have you verify this at our station in this city. The writer gives our battery "only two years of constant service." We thank him for that concession, for we only ask six months' constant service in order to compete with the cost of horse-traction. He probably forgets that the material in the battery is not destroyed when the "usefulness" of the battery ends, but is again made over into battery by a process so cheap as to compete favorably with the maintenance of horses.

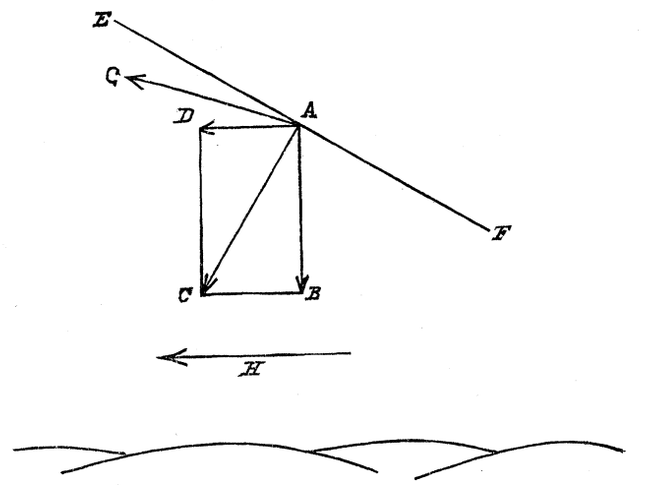
One word more, Mr. Editor, and I have done. Our 18-foot cars, Nos. 1 and 2, now in the service of the Fourth and Madison Avenue lines, in this city, run from 86th Street and Madison Avenue to the Post-Office, and back, — a distance of twelve miles, — on an expenditure of less than fifteen horse-power hours of energy, and frequently carry over two hundred passengers on the round trip. This seems almost too good to be true; but you would do us a favor by inspecting the records at our station, and verifying this statement for yourself. With storage-battery traction there can be no mistaking the amount of energy expended; for we know the number of horse-power hours that are put into the battery, and of course the number of miles such charge will carry the car. Now, for the information of the public, we think it but fair that the Hauss Electric Railway should tell us how far fifteen electrical horse-power hours has carried one of their cars. The comparison would be very interesting.

WM. BRACKEN.

New York, Jan. 5.

The Soaring of Birds.

IN a recent number of *Science* (xii. p. 267) I notice an article under the above heading. It seems to me that we have not yet got to the bottom of the matter, and that the true explanation of the phenomenon is still simpler. Imagine a piece of paper floating in the air. The wind takes it, and carries it along horizontally with its own velocity. After it has assumed the velocity of the wind, there is but one force acting on it; namely, the vertical one due to its own weight. Imagine now a bird under the same circumstances. Instead of travelling with the wind, as everybody who has watched a



soaring bird knows, he travels round and round in circles, each one a little higher than the last, and each one a little farther along in the direction towards which the wind is blowing. Now, when he travels with the wind, he attains nearly its velocity, and then turns and travels against it, rising rapidly at the same time, till he is nearly stationary, or perhaps is even going a little backwards, relatively to the ground. He then turns and travels with the wind again, either moving along horizontally, or perhaps dropping somewhat nearer the earth, until he attains his original velocity, when the cycle is repeated. Comparing his motion with that of the paper, we find that he does not move along so fast: there must, therefore, be some compensating advantage obtained, in order to use up the surplus energy derived from the wind.

In the above figure let H represent the direction of the wind, and A the position of the bird. Let AB represent the force due to his weight, and AD the mean force exerted on him by the wind, owing to the fact that he does not move along as fast as the surrounding air. Combining these, we get the resultant force AC acting upon the bird. Now construct the plane EF perpendicular to the line AC. The bird may then move anywhere in this plane without losing energy. He cannot move to the right of it, but he may move to the left, and thus gain energy. Practically he will move in a spiral about the line AG, thus slowly dropping from the plane